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UNITED STATES
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FISH AND WILDLIFE SERVICE
Albert M. Day, Director

Special Scientific Report No. 28

HARBOR SEALS AND SEA LIONS IN ALASKA

By

Ralph H. Imler
and
Hosea R. Sarber

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Explanatory Note

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Commercial fishermen in Alaska have long considered the harbor seal (Phoca vitulina) and the Steller sea lion (Eumetopias jubata) as serious predators on fish. Complaints against these mammals have been so numerous in recent years that the Fish and Wildlife Service felt obligated to undertake a study of their habits and depredations. Stomach collecting was begun in 1945 by Sarber while Imler spent 5 months each during the summers of 1945 and 1946 in Alaska collecting seals and sea lions and gathering data on their distribution and feeding habits.

The work on harbor seals centered on the deltas of two large rivers, the Stikine in southeastern Alaska and the Copper in the "Gulf" area of Alaska near Prince William Sound.

Sea lion collections were made at various rookeries extending along the Alaskan coast from Sitka to Kodiak Island.

HARBOR SEALS

Distribution and Abundance.

Harbor seals were found to be common throughout the coastal regions studied. They fed almost entirely on fish, and, consequently, often congregated near the mouths of streams where fish were running. The largest concentration of harbor seals observed was on the Copper River delta. In that area it was not uncommon to see herds of more than 100 animals hauled out on the sand bars at low tide.

An airplane flight, which covered about one-half of the outer bars of the Copper River "flats", was made on June 19 to observe seals (Figs. 1 and 2). A total of 1618 seals was tabulated, and the three largest herds were estimated to contain 300, 240, and 220 animals, respectively. Since the flight covered about one-half of the bars, the figure of 1618 represents something less than one-half of the seals using the bars. Some small herds were no doubt overlooked, and one can be certain that there were seals out in the ocean beyond the bars. There were also many seals up the numerous river channels of the delta where a thorough survey had been made by boat during the preceding week.

A summary of all available data indicates that there are not less than 6,000 harbor seals living in the Copper River delta, and even this figure may be somewhat low. This is more than the 1945 estimate and is no doubt more accurate, but it is still far below some local claims that 50,000 seals are living on the Copper River delta.

When Ralph Renner and Walter Mantilla, residents of Cordova who have done lots of seal hunting for bounty, were asked for an estimate of the number of seals living on the delta, Renner stated, "There are probably about 5,000 or 6,000," whereas Mantilla's comments were, "I think there are at least 10,000, although there is no way to count them because they shift so much you can't see them all at once. Then there are lots of seals still in the 'outside' ocean even when you see herds hauled out on the bars."

Notes on harbor seal observations were recorded daily during the 5 weeks' study on the Copper River. On June 12, near the height of their pupping season, approximately 280 seals were observed around the mouth and in the lower three miles of King Salmon Slough. A large run of eulachon (Thaleichthys pacificus) was moving up this stream, which is a part of the Copper River, and the seals were feeding exclusively on these fish. On June 26, 420 seals were recorded on a 35-mile trip over the flats. When first observed most of them were in herds out on the bars.

On the other hand, examples of seal scarcity are shown by the following records of boat mileage and seals observed on trips in the Copper River area: June 4, 18 miles, 5 seals; June 6, 26 miles, 11 seals; June 14, 31 miles, 14 seals, and June 24, 27 miles, 19 seals.

During 539 miles of boat travel over the delta between May 22 and June 26 a total of 2680 hair seals were observed. This is an average of less than 5 seals seen per mile travelled.

A similar census, taken during 827 miles of boat travel in south-eastern Alaska, revealed only 475 seals, an average of .56 seal per mile of travel. A heavy concentration of hair seals was noted along the southern shore of Kupreanof Island during the last week of August. One herd was estimated to contain at least 70, and several others, comprising 30 to 50 animals each, were observed.

Depredations

The predations of harbor seals on salmon is most serious in areas where gill nets are used. When salmon are taken by this means, they may be caught for several hours before they are removed from the net, thus giving the seal a chance to prey on the entangled fish (Fig.3). In tending such nets the fishermen are often several hundred yards from the farther end, and the harbor seals are quick to take advantage of such opportunities. Seal damage to gill-netted salmon may be so severe that the fishermen are forced to move to new grounds, but such occasions are rare even on the Copper River delta.

The two principal gill-netting areas in Alaska are the mouths of the Copper and Stikine Rivers, and it is here that most of the complaints of seal depredations originate. Consequently, the investigations centered in these two areas, and from May 28 to June 26, 1946 Imler was continuously with the Copper River gill-netters. During this time 10,863 netted salmon were inspected for evidence of damage done by harbor seals, and the total loss observed was estimated as equivalent to 92 fish, or .85 of one per cent of the catch. This figure is less than the actual loss because many badly mangled fish were immediately discarded by fishermen. Also, there are some salmon that are pulled completely out of the net by the seals, and these, of course cannot be tabulated, nor even estimated with any degree of accuracy.

After consideration of all the available facts, we feel certain that the total loss of salmon due to seal depredations on gill-netted fish will not average more than 2% of the catch on the Copper River flats. Individual fishermen may occasionally experience much greater loss, but there are also many who find no damaged fish for weeks at a time.

The total catch of red salmon on the Copper River in 1945 was about 70,000 cases. These were valued at \$13.00 per case, totaling \$910,000.00. Even one percent of this amount would be over \$9,000.00. Imler believes that \$15,000.00 would be a conservative estimate of the value of red salmon destroyed by harbor seal predation on the Copper River delta in 1945. To obtain the total annual loss one would have to add to the above figure a similar loss which is experienced during the fall fishing season for silver salmon.

On September 5-6, 1945, the salmon catch from 21 boats fishing the Stikine River flats with gill nets was examined as they were unloaded at the buyer's scow. The total catch of these netters was 2044 silver salmon of which they reported 59 were damaged by hair seals. The actual loss to the fishermen, however, was only 27 salmon since the buyer accepted the remaining 32 even though they would average at least 25 percent less usable salmon per fish than the run of the catch. The actual salmon loss then, was 35 fish from 2044 or about 1.7 percent of the day's catch. Although a part of this "reported" loss was accepted without the investigator actually seeing the damaged fish, the count is believed to be reasonably accurate. The two following examples reveal severe depredations that were occurring at that time:

Sept. 5, Stikine River flats.

(1) Observed one gill-netter unload 62 silver salmon of which 4 were slightly damaged but salable: 3 badly mangled and worthless "head portions" of salmon were observed in this fisherman's skiff and he said that he had thrown two similar ones away.

(2) Another fisherman unloaded 83 salmon and 6 of them had bites taken out by harbor seals. This same man stated that he had on that date thrown away 5 fish that were not worth bringing in to the scow.

Since the "fishing area" on the Stikine River is much less extensive than that of the Copper River it is probable that the smaller seal population of the Stikine River may inflict fully as great a percent of loss to gill-netted salmon as occurs on the other fishing grounds mentioned.

Hunting and Control of Seals.

There are a number of methods used in hunting and collecting the spotted hair or harbor seals in southeastern Alaska, depending largely on the locality and the time of the season. Hunting by rifle is by far the most successful and effective means for taking them in numbers. (Fig. 4) Under certain conditions on some of the sloughs and branches of the Stikine River, however, shotguns can be used successfully for a few weeks each spring during the pupping season.

At this period the females and new-born pups can be approached closely enough by speedboats to permit taking them with shotguns. For this type of hunting two men are required, one man operating the boat and motor, while the man forward directs all his attention to locating and shooting the seals. The seals are shot while the boat travels at full speed, and are picked up by the operator, who hooks them with a special gang or multiple hook attached to a long handle. The boat is stopped barely long enough to hook and take the seal aboard, then started again.

One of the most successful methods of hunting the harbor seal

is in pass shooting. This type of hunting is practiced mostly during the spring months, however, and only in favorable locations. The hunters remain quietly on a vantage point on shore, where the seals are shot as they pass to and from their feeding grounds. They pass these points on the rising tide as they travel to the flats and stream mouths to feed, then again as they return on the falling tide. It is possible for one or two men to shoot as many as 15 to 20 on a single tide in this manner in the Stikine River area during the spring months.

Another method of hunting these seals, practiced by only a very few of the hardest hunters, however, is to enter the ice flows at the face of some of the glaciers during the pupping season in late May and June. Herds of seals haul out on the ice flows near the glaciers, where the pups are born, and by working special skiffs or row boats through and over the floating and jammed ice, a great many seals can be shot. Many of them so shot are lost, however, because the hunters are often unable to reach them before they sink or disappear in the running ice. Often, too, it is impossible for a man to get to a seal shot in such places. This method is little used because of the difficulties and dangers involved.

Other than in a few locations as described above, harbor seals are collected over most of the year wherever they are found. They occur in varying numbers around many stream mouths and tidal flats throughout the inland waters of southeastern Alaska and also about rocks and reefs that afford both food and protection, and make it difficult or impossible for man to approach them undetected. In such places there are usually from one or two animals to as many as several dozen in a herd. While they are not a migrating animal they readily travel from one location to another in such bands, and will often cover from ten to fifteen miles in a single trip if disturbed.

When seals are located the hunter simply hurries ashore at a chosen vantage point where he quickly shoots as many seals as possible. They always take to the water immediately upon the slightest disturbance and all the shooting must be done at the swimming seals. They are always in the water before a landing can be made; but by picking off as many as possible immediately, then by waiting quietly out of sight usually a number of the more curious and those that have lost an immediate companion can be picked off. Often one or two to as many as six or eight seals can be shot in this manner at a single location.

No matter what type of hunting is undertaken there are many difficulties and hardships encountered in taking harbor seals in considerable numbers. As indicated they must be shot in the water, and the target presented is only the head, or only a part of it, showing above the water. This target averages smaller in size than a man's two fists, and the ranges are anywhere out to 300 yards or more, with the average being perhaps about 200 yards. Moreover, the target usually is a moving one due to the seal's swimming or because of rough water.

This type of collecting requires the finest of equipment in superbly accurate rifles of very high velocity and low trajectory curve. Equally accurate telescope sights must be used, preferably those of rather high power and of the target type, capable of being adjusted to a fraction of a minute of angle. The most accurate of high-power calibers in heavy barreled rifles and the finest of hand loaded ammunition are desirable for this work.

When a seal is shot, it is picked up as quickly as possible to keep it from sinking. For this purpose an outboard speedboat is ideal. Often, if a second man is ready in the speedboat, a seal can be gotten that would otherwise sink. They will often float for only a minute or less; many times for only a few seconds. Many of them sink immediately when shot and are, of course, lost.

Many theories have been advanced by seal hunters as to why some seals sink so readily, especially during certain periods of the year. Some claim it is because of their food, and that while on a diet of salmon they sink more readily than when subsisting on other food. Others advance the theory that it is because of shedding. Often a "sage" will offer the advice, "shoot him just before he goes down and he will float." Of course, this advice is impossible to follow because there is no way to determine when the seal is ready to disappear!

Seal hunters often claim that shot seals will sink more readily during the mating period. However, the mating period is not definitely known. Fetuses of from a fraction of an inch to about $1\frac{1}{2}$ inches in length are found from mid-October to well into November.

There are periods of the year when the hair seals sink much more readily than at other times. Beginning in late August usually, and up to mid-November or later they sink so readily that it is hardly worth while shooting them, unless they are found on flats where the receding tide will leave them exposed at low water. During such periods at least 8 out of 10 seals shot will sink, while during late winter and spring over three-fourths of them will usually float. Roughly, about 40 per cent of the seals shot in year-around hunting will sink.

During late summer and fall hair seals shed their coat of hair, the new coat being exposed as the old is shed. During this period they lose much of their blubber and are not nearly so heavy as during late winter and spring when they are fattest. The blubber lies in a solid layer just under the skin and completely encases the carcass. This "blanket" of blubber often reaches a thickness of $1\frac{1}{2}$ to 2 inches and will weigh up to a hundred pounds or more in large adults.

A governing factor of whether a seal sinks or floats when shot is whether or not the air stays in them. For some reason not known the air will not stay in some of them, but will bubble out from the

nose and mouth, when they immediately sink. Some of them will float all day. Often, however, a floating seal is sunk because of rough water, which rolls them about on the surface, causing the air to bubble out. No seal will float unless the air or a part of it remains in the lungs.

Some seal hunters were found "manufacturing" scalps from the hides of harbor seals in southeastern Alaska in 1946. Bounties may have been paid on a number of such scalps before the fraud was detected. It appears to the writers that the tail of harbor seals would be much better than the scalp as a basis on which to make bounty payments. The tail could be quickly cut from the animal in the field and could be easily preserved in brine or formalin. It has been used for bounty purposes in Norway, and we believe that it would be extremely difficult, if not impossible, for anyone to "manufacture" an article which would really look like the tail of a hair seal. The snout, used in the state of Washington as a basis of bounty payment in 1947, also has advantages in preventing fraud.

Pupping:

Harbor seals begin pupping in late May, but most of the young are born during the first half of June. Hosea Sarber shot a pregnant seal in Tebenkoff Bay, Kuiu Island, Alaska, on June 22, 1943, the latest date he has ever found seals carrying young. The pup was about to be born. Imler picked up two newly born seals on a bar of the Copper flats on June 6, 1945, (Fig.5). These pups were deserted when a flock of some 300 seals were routed by rifle fire and the roar of the 33 horsepower outboard motor. The fresh after-birth and sloughed-off hair of the prenatal coat were found near each seal and since they were born on a spot less than 2 feet above the ebbing tide, neither seal could have been more than two hours old. An examination of the exposed bar revealed that five seals had been born that afternoon in a 200 yard stretch along the water's edge, but three of the newly born pups had made the water and swam off with the adults.

The following measurements were taken of the two newly-born seal pups:

	<u>Weight</u>	<u>Total Length</u>	<u>Tail</u>	<u>Girth</u>
Male	30 $\frac{1}{4}$ lb.	33-3/8 in.	4 $\frac{1}{2}$ in.	21 in.
Female	16 $\frac{1}{2}$ lb.	28-3/4 in.	4 $\frac{1}{2}$ in.	17 $\frac{1}{2}$ in.

The largest adult harbor seal collected was a male that was 64 $\frac{1}{4}$ inches long and measured 46-3/8 inches in girth just back of the flippers. It was taken May 30, 1946 on the Copper River delta.

The young seals are born with the regular or adult spotted coat of hair; the much longer, silvery, and unspotted, prenatal coat being shed before birth. We have never known of a pup to be born before it

had shed its first coat. In collecting many scores of females carrying pups, Sarber has never found a pup about to be born that had not shed its initial coat of hair. Also, he has never known of a female hair seal to give birth to more than a single pup at a time, nor has he ever found evidence of twins having occurred.

Utilization of Hides and Carcasses.

Harbor seals are used, whenever they can be obtained, as food for foxes on many fur farms in Alaska. Bert McCay, who operates a fox farm in the Kashevarof Islands near Wrangell, stated that his foxes did well on seal carcasses.

Some of the Alaskan natives eat seal meat occasionally, but it is not generally an important food item in the areas visited. The liver of seals is especially mild flavored and is eaten by whites as well as natives.

The hides of seals are not usually saved when the animals are killed. This is especially true of bounty hunters who are after as many scalps as they can get and have no time for skinning. The few hides that are kept usually are skinned out by the native Indians to be made into mocassins and other souvenirs.

Many more pelts of harbor seals would be marketed in Alaska if permanent, dependable markets were established. Such markets are especially needed in Cordova and Wrangell. At present seal pelts are occasionally purchased in various localities, but we found no permanently established buyer for unlimited numbers.

There is some current demand for sport coats made of harbor seal skins. Such coats are very serviceable and quite attractive when they are well made. Pelts of harbor seals are also used in making "climbers" for skis.

The Fisheries Research Laboratory of the Fish and Wildlife Service at Ketchikan is experimenting with various uses for seal meat and oil.

Stomach Analyses

Stomachs of nearly 400 harbor seals have been opened for food analyses during this two year study. Many, found empty, were discarded in the field, and only 166 contained sufficient food for tabulation purposes (Table 1). Of this number 67 were taken on the Copper River delta and 99 in southeastern Alaska. Of the latter figure 23 were collected on the flats of the Stikine River or in nearby waters.

Seals collected in the Copper River district were feeding almost entirely on eulachon (Thaleichthys pacificus). Of the 67 stomachs tabulated from that area 64 contained only eulachon,

two contained salmon and one, cod. Since work on the Copper River was restricted to late May and June (the season where eulachon were running) it was not surprising to find them a major food item; however, such complete feeding on a single species is unique. Lack of equipment and field assistance while working in the vicinity of the Copper River made it necessary to restrict most of the studies in that area to the more or less "protected" waters.

The two seal stomachs containing salmon were from seals collected on bars well out in the flats. More extensive collections should be made in such areas to obtain a full picture of the food habits of harbor seals on the Copper River fishing grounds. However, such collections can be made only with fast speed boats and a two-man crew. If such investigations were made during the fall coho season when eulachon are not present, a better idea of harbor seal predations might be obtained.

The seals collected in southeastern Alaska were quite representative of the area. Some were shot on the Stikine flats and others at different points along the mainland, while many were taken on Admiralty, Kupreanof and Prince of Wales Islands.

The 99 seals tabulated from this area in southeastern Alaska were feeding extensively on gadids (22.6%). Alaskan pollack (Theragra chalcogramma) was the principal species since it made up nearly $\frac{2}{3}$ of the gadid contents, while Pacific tom cod (Gadus macrocephalus) was also a common food.

Herring (Clupea pallasii) ranked as the second most important fish food, comprising 16.4 percent of the total. The seals often fed on small (2 to 3 inch) herring as well as the larger ones. Both herring and gadids were eaten throughout the year.

Flounders constituted 11.1 percent of the food, and those eaten were mostly small soles and arrow-toothed halibut (Atheresthes stomias). We found no evidence of seals taking the commercial halibut (Hippoglossus hippoglossus).

Eulachon (Thaleichthys pacificus) and salmon were prominent foods in 1945 but much less so in 1946, when the salmon run was very poor.

Other fish taken in much smaller quantities were sculpins, rockfish (Sebastes sp.) and blennies. A single seal had fed on a skate (Raja inoculata).

Shrimps (Caridea) appeared to be a choice food of harbor seals during July and August in certain localities. Most of the animals that had fed on shrimp were found to have nothing else in the stomach, and this food item made up 17.3% of the seal's food.

Three seal stomachs were filled with remains of octopus and five others had lesser amounts, giving this food a total of 3.3 percent in the seal's diet in southeastern Alaska.

TABLE I
STOMACH CONTENTS OF HARBOR SEALS FROM S.E. ALASKA
Figures represent percentages by Volume and by Frequency.

	39 Seals, 1945		60 Seals, 1946		99 Seals, 45-46	
	By Volume	By Frequency	By Volume	By Frequency	By Volume	By Frequency
G. dids	20.3 (14.1) ^{1/}	28 (15.0)	24.2 (13.4)	30 (23.0)	22.6 (13.7)	29 (20.0)
Herring	21.7	28	12.9	17	16.4	21
Flounders	7.5	8	13.4 (8.6) ^{2/}	20 (12.0)	11.1 (5.2)	15 (7.0)
Dulachon	19.7	21	5.0	5	10.9	11
Salmonids	19.5 (12.8) ^{3/}	21 (13.0)	1.7 (1.7)	2 (2.0)	8.6 (6.1)	9 (6.0)
Sculpins			3.4	3	2.0	2
Rockfish			1.7	2	1.0	1
Blennies			1.7	2	1.0	1
Skates			1.5	2	.9	1
Unidentified Fish	3.6	5	5.5	8	4.9	7
Fish Total	92.3	92	71.	75	79.4	82
Shrimp	7.7	8	23.5	37	17.3	25
Octopus			5.5	13	3.3	8

Figures in parenthesis represent (1), Alaskan pollack under the gadids;
(2), Arrow-toothed halibut under the flounders, and
(3), Salmon under the Salmonids.

SEA LIONS

This Alaskan investigation was concerned chiefly with harbor seals, but some data on the distribution and feeding habits of sea lions were recorded. Most of the observations and collections of sea lions were made in 1945, although six stomach samples were taken from the herd at the White Sisters Islands in August, 1946. Another sea lion collected at the Brothers Islands above Petersburg made up the total of seven stomachs taken during the 1946 season.

Several attempts were made to observe sea lions by accompanying commercial halibut boats, but none was found with accommodations for more than the crew, and Service ships were seldom on the halibut fishing grounds for any length of time. However, some brief daytime periods were spent on each of three different halibut boats.

Distribution.

Sea lion rookeries were visited and stomach samples were taken wherever possible. Much information was gathered on the abundance and distribution of these mammals but, due to the inaccessibility of the rookeries along with transportation difficulties, the food habits data obtained were rather meagre.

The largest sea lion herd observed was on the Barren Islands where there were an estimated 4000 sea lions. Three animals were collected there July 11, 1945.

About 1800 of these mammals were in a large rookery on the Chiswell Islands near Seward and an additional 400 on Seal Rocks nearby. On July 13, 1945, five sea lions were killed in that area, but, due to the rough sea, only 2 were recovered for stomach samples.

Several small rookeries and "hauling out" places were visited around Kodiak. The largest number of sea lions observed at one time in that area was about 75 near Bumble Bay, but much larger herds were reported by Wildlife Agent Marcus Meyers who is stationed at Kodiak.

Another group of seal rocks 10 miles off Cape Hinchinbrook in Prince William Sound was visited on June 11 and June 20. There were about 300 lions in the herd and nine were killed on the latter date, but 4 rolled into the surf and sank. There was no food in the stomachs of the adults examined, due possibly to the fact that they were taken during the supposed breeding season.

The largest herd of sea lions observed in southeastern Alaska was found on the Hazy Islands. About 350 were seen there on August 21, 1945, but the sea was too rough to permit a landing. Another herd of nearly this size was located on Forrester Island. At least 200 lions were observed on the White Sisters Islands on August 11, 1946. Other hauling out places are scattered along the outer coasts of Prince of Wales, Baranof, and Chichagof Islands. According to local reports, many of these animals move into the "inside" channels during the winter months.

While considerable time was spent in travel to and from sea lion rookeries, especially during the summer of 1945, none of the "shore visitations" at these rookeries lasted more than 2 hours. On several occasions, particularly while aboard the M.S. Brant in August 1945, long trips were made to large rookeries only to find the sea too rough to permit a landing. Since the dead lions would not float, they could not be collected at sea.

Depredations and Control.

Reports of sea lion depredations indicated that they were fully as troublesome during 1946 as they were in 1945. Most of the complaints came from fishermen taking halibut and sablefish between Cape Ommaney and Cape Spencer.

Farther to the northwestward in Alaska sea lions reputedly cause considerable loss to halibut fisherman on the extensive Portlock Banks. There are many large sea lion rookeries bordering these great halibut fishing grounds.

Imler spent several periods of a few hours each on halibut fishing boats, but no sea lions were sighted on any of these occasions. While it is known that sea lions take hooked fish from fishermen's gear, we have no specific information on the actual loss thus involved. There is need for further study of the sea lion's feeding habits, but such work should not be undertaken until a large boat capable of navigating the outside waters can be given full time detail to these investigations.

The number of sea lions usually found pestering a fishing boat is small, generally 2 or 3 up to 5 or 6 at most. However, the fishermen report that a single sea lion may follow a boat for hours and take many fish from their gear.

The sea lions reputedly take the fish as they are being hauled up but before they reach the surface. They will jerk the fish from the line and swim off under water. When about 200 yards or more from the boat, they come to the surface to eat their prey. Fishermen report that the lions hold the fish up and throw it into the air. They are probably doing this to tear bites out of the fish.

Many halibut boat skippers were interviewed to obtain their story of losses to sea lions. They often made entire trips (usually about 10 days duration) without having any trouble with sea lions, but reports of heavy losses were equally common. It was not unusual to hear that the lions had taken 10 or 15 percent of the entire catch for a trip.

The following accounts are typical of the reports obtained:

May 13.

John Otness, skipper on Teddy J. of Petersburg: "We saw several sea lions -- only 1 to 3 at a time -- but they did not bother us this last trip. They have caused us plenty of trouble other times, though. We shot at one on this trip and think we killed it."

May 14.

Casper Hallingstad, skipper on Brooklyn of Petersburg: "Sea lions took lots of fish from us. Seemed like there was 2 or 3 around most of the time. We shot and killed one at close range. We could often feel them on the line, and one came up with a large halibut in its mouth. We lost a good many fish to them this trip but don't know how many."

August 3.

Ole Sgursen, skipper of Lansing of Sitka: "Saw at least 50 sea lions on our last trip; usually 2 to 4 at a time. Killed one and crippled one with 250 Savage. They probably got 100 pounds of our fish anyway but would have taken much more if not shot at." A member of the Lansing crew who had fished the Sitka area for over 20 years said: "There are fewer sea lions here now than there were 20 years ago, but there are many more to the westward."

August 4.

Harold Engdahl, captain on Liberty of Seattle: "Sea lions took at least 50 percent of our catch of halibut on July 30 and 31 while fishing 6 miles south of Chernabura Island. They are the fishermen's worst enemy. They are worse now than they used to be more of them."

These examples are representative of the dozens of interviews recorded. Although there is a tendency among fishing men to exaggerate losses due to sea lion predation, nevertheless, there is certainly an actual economic loss resulting from sea lions taking halibut and sablefish off the fishermen's gear. This loss is perhaps often in excess of five percent of the catch and occasionally much more.

Many trollers also were interviewed in reference to predation and, while they uniformly denounced the sea lions, it was evident that their actual loss is much less than that experienced by halibut fishermen, and not sufficient to create a depredation problem of any significance. These trollers are all salmon fishermen and, while they do not complain a great deal about sea lions, they are occasionally bothered by them. Numerous interviews revealed the fact that very few trollers lost more than six or eight salmon per year to sea lions, and many fished an entire season without a single fish being taken by these mammals.

Sea lions cause some disturbance at salmon traps on the Alaska Peninsula and in lower Cook Inlet. In the latter area in 1945 one trap had caught 13 lions and another 8 before we visited them on July 14. When these animals enter a salmon trap, they keep additional fish from entering and may kill many of those that are already trapped. Watchmen usually shoot the trapped lions, but they cannot remove them from the trap until the tender (cannery ship) arrives with its power hoist.

The effect of gun fire in keeping sea lions away from fishing boats is a controversial subject in need of much further study. Most of the fishermen state that they carry guns and often use them when sea lions are around, but, while the guns are a great help, it is impossible to prevent all depredations by shooting. They offer two reasons for this: first, each man has a certain job to do when fish are being hauled in, and it is disrupting to their fishing for any one man to stop work to shoot sea lions; second, they say the sea lions "get wise to guns" and learn to take the fish under water, then swim out of rifle range before surfacing. Of course, the ships are nearly always rolling with the sea, and this adds to the difficulty of efficient shooting.

It should be noted here that halibut and sablefish are caught by "bottom fishing"; that is, the baited lines are set on the ocean floor. The depth is usually too great for sea lions to reach the set gear but they follow the boats and take the fish under water as they are being hauled upward to the boat. After they have pulled a fish off the gear, or have bitten off a portion of it, they swim out a considerable distance from the ship before they surface to eat the fish. After the lions have fed well on a few fish they reputedly continue these activities for some time by eating only a small portion of the belly of each halibut or sablefish.

The most effective means of controlling sea lions would be to reduce their numbers by killing them on the rookeries and hauling-out grounds. This could be most efficiently done during the spring pupping season, but it could also be effectively continued through the summer.

Such control of sea lions has been practiced by the Canadian government, and there is no doubt that similar control in Alaska would save many tons of commercial fish. This control is especially needed at the large rookeries, such as the Chiswell and Barren Islands. It might also be practiced to a lesser extent on the rookeries at Sea Rocks off Cape Hinchbrook, or the White Sisters Islands in southeastern Alaska. It is Imler's belief that such control should first be carried out on an experimental basis. For example, the Agent at Cordova could manage control work at the rookery off Cape Hinchbrook, while the Agent on the M.S. Grizzly Bear, which patrols the Sitka district, might make the necessary reductions in the herd using the White Sisters Islands.

While extermination of sea lions on any area is not recommended, it is felt that any rookery of 200 or more sea lions located in areas of extensive commercial fishing could be reduced to fifty percent of their present numbers with a great saving of food fish, and without jeopardizing the sea lion population.

Utilization of Sea Lions.

Sea lions are occasionally fed to foxes on the various fur farms in Alaska. Bert McCay, a fox farmer of many years' experience in Clarence Strait, said that he considered harbor seals and sea lions to be the best fox feed he had ever used; however, the lions cannot be legally killed for that purpose under present regulations.

Sea lions also are eaten by Alaskan Indians. Sarber found them eager to get the meat from one which he killed near the mouth of the Stikine River. Natives in Prince William Sound (especially those near Latouche and Port Ashton) are reported to eat sea lions quite regularly during the winter months, while farther to the north, beyond the Alaska peninsula, they are a staple food of the natives.

The hide of sea lions has been used to a rather limited extent in leather-making, and it is said to be quite water resistant. The leather is so thick that it requires splitting for most uses. In Canada this leather has been used in limited quantities for gloves and shoes.

The Fisheries Research Laboratory at Ketchikan is making a study of the utilization of the hide, blubber, and carcass of sea lions. If they can find a profitable means of marketing these animals, their numbers could be reduced by such usage; however, before this could be done there would have to be a change in the law protecting these mammals.

Since we can see no reason for the protection of sea lions in southeastern and western Alaska, and since the law prohibiting their killing is generally disregarded, it seems that the protection of these mammals should be removed. Such removal of protective laws might be of some help in controlling sea lions in southeastern Alaska; however, it would have very little effect in other parts of the territory. Any large scale experiments in sea lion control should be carried out on the rookeries between Seward and the Shumagin Islands. Either the Barren or Chiswell groups would be especially suitable for such work.

There is no reason for anyone to be fearful that great numbers might be killed in a short time. If this were possible, the fishermen would have eliminated sea lions in Alaska long ago. As a matter of fact the animals are quite wary, and two or three gun shots are sufficient to send an entire rookery plunging into the sea. A few follow-up shots will usually drive the herd out of rifle range. After that it is a long waiting process to collect a few of the animals as they gradually return to their "hauling out" grounds.

Stomach Analyses.

About 50 sea lions were collected during this two year study in Alaska, but many of them rolled from their rocky perches into the ocean and sank before they could be reached. At least 20 were killed in the water and only one of these floated. A total of 23 lions were recovered and food samples were obtained from 15 stomachs which contained food. The results of these analyses are summarized in Table II.

Of the eight lions collected in southeastern Alaska, all but one had fed principally on pollack. The one exception had filled up on a skate and an octopus.

Three sea lions collected July 11, 1945 on the Barren Islands revealed the greatest variety of food items which included pollack, starry flounder, tom cod, arrow-toothed halibut, common halibut, and octopus (Fig.6). The common halibut which constituted 10 per cent of the food in one of these stomachs was the only occurrence of this fish in the 15 stomachs examined.

Three sea lions were collected July 31, 1945 on the Chiswell Islands. One had no food in its stomach but the other two had fed entirely on salmon. One of these contained an eight pound red salmon which had been swallowed entire. These were the only salmon found in sea lion stomachs.

Two sea lions that were collected August 2, 1945 near Bumble Bay on Kodiak Island had fed on pollack and arrow-toothed halibut.

It appears, from the examination of 15 stomachs that "scrap" fish made up most of the Alaskan sea lion's food. Salmon and common halibut, which were the only fish of commercial importance found in sea lions, comprised 14 per cent of their stomach contents.

There is undoubtedly much truth in the numerous reports that sea lions take many halibut and sablefish from the fishermen's gear; however, we have no evidence that these species constitute a major portion of the normal diet of sea lions. It may well be that a minor part of the sea lion population is responsible for most of the predation and such deep water fishes as halibut and sablefish may be seldom taken in the free-swimming state.

TABLE II
SEA LION STOMACH CONTENTS

(Figures indicate percentages by volume)

Stomach Catalog Number	Alaskan Locality	Date	Pollack	Salmon	Starry Flounder	Tom Cod	toothed Halibut	Common Halibut	Skate	Unid. Fish	Octopus
56838	Lynn Canal	May 8, 1945	96		tr	4					
56840	Barren Is.	July 11	94					6			
56842	" "	" 11			90	tr		10			
56843	" "	" 11		6		55	6			3	30
56844	Chiswell Is.	" 31		100							
56845	" "	" 31		100							
56846	Kodiak Is.	Aug. 2	65				35				
56847	" "	" 2	90				10				
57150	Brothers Is.	May 18, 1946	84				12			4	
57257	White Sisters Is.	Aug.	100							tr	
57258	" "	" "	100								
57259	" "	" "								100	
57260	" "	" "	100								
57261	" "	" "	90						10		
57262	" "	" "							65	35	
Totals			825	200	90	59	69	10	75	103	69
Average percentage			55	13.3	6	4	4.6	0.7	5	6.8	4.6

Much additional research and more stomach analyses are necessary for a better understanding of the economic importance of sea lions in Alaska.

CONCLUSIONS

1. Harbor seals were common throughout the southeastern and gulf areas of Alaska but they were most abundant near the mouths of the larger streams.
2. On the delta or "flats" of the Copper River herds containing more than 200 harbor seals were observed and the seal population of the entire delta was estimated to be at least 6000.
3. In the vicinity of the Copper River seal predation on gill-netted red salmon accounted for about 2 per cent of the total catch. A conservative evaluation of \$15,000 was placed on the red salmon destroyed in 1945. The total loss for the year was much more than this since seals also preyed on the fall run of silver salmon.
4. On the flats of the Stikine River the percentage of loss was slightly higher, but, due to a smaller catch of fish, the total loss from the seal depredations was much less than that which occurred on the Copper River.
5. Harbor seals were effectively hunted with shotguns from speedboats for a short period during the pupping season, but for the remainder of the year the most effective means of taking them was by rifle fire from the shores.
6. About 40 per cent of the seals shot in year-around hunting sank before they could be reached. They floated best from late winter to midsummer.
7. The pupping season began during the last half of May and extended to about June 20. On the Copper River "flats" many seal pups were born on bars which were exposed only at low tide. It was evident that seals could swim well when only two or three hours old.
8. Some use has been made of harbor seal hides but there is need for a dependable market and the Fish and Wildlife Service should assist in the establishment of such markets at Wrangell and Cordova.
9. On the Copper River Delta the harbor seals were feeding principally on eulachon (Thaleichthys pacificus) during May and June but they were also taking some salmon.
10. In southeastern Alaska the most common food in seal stomachs was gadids (pollack and tom cod). Other items of frequent occurrence were shrimp, herring, flounder, eulachon and salmon.

11. It is concluded that the harbor seal is an insignificant factor in the conservation of the salmon runs. It is, however, a costly nuisance to the salmon fishermen using gill nets.

12. Sea lions inhabited the entire coastal area of southeastern Alaska where their total population was probably not more than 3000. From Seward westward they were much more abundant. The herd observed on the Barren Islands was estimated at about 4000 lions on July 11, 1945.

13. Fishermen often exaggerated their losses but, nevertheless, sea lion predation on halibut and sablefish at times exceeded 5 per cent of the catch and instances of much greater damage occurred.

14. Sea lions cannot be effectively controlled by gunfire from fishing boats because the roll of the sea renders shooting inaccurate. The most efficient means of controlling them would be to kill the animals on their rookeries during the breeding season.

15. Analyses of the stomach contents of 15 sea lions disclosed that fish of commercial importance (salmon and halibut) constituted only 14 percent (by volume) of the total food. Although no herring were found it is well known that sea lions feed on this species.

16. The flesh of both harbor seals and sea lions was eaten by Alaskan Indians. These animals were also utilized for fox feed.

17. The Fisheries Research Laboratory at Ketchikan, Alaska is experimenting with various uses for harbor seal and sea lion carcasses.

RECOMMENDATIONS

1. With the passing of wartime conditions and the growing demand for pelts, it is believed that harbor seals will be more extensively hunted and no Federal Reductional control of numbers will be necessary.

2. Hunting pressure on these animals might be increased by raising the bounty from the present \$3.00 to \$5.00, but any contemplated action of this kind should take into consideration the numerous disadvantages of the bounty system. By using the seal's tail or snout rather than the scalp for bounty purposes, much time would be saved for the hunters and the faking of scalps would be prevented.

3. The establishment of dependable markets in Wrangell and Cordova, Alaska for hides of harbor seals should be strongly encouraged. This might be done in cooperation with the Indian Service.

4. Since sea lions are an important fish predator in Alaska, all restrictions on the killing of them should be removed except in certain areas where they are objects of wildlife interest and do little harm.

5. It is apparent that sea lions in Alaska should be reduced in numbers and the fishermen are unable to handle this problem, under present conditions.

6. This should be done first by experimental control carried on at one or two of the most objectionable rookeries to determine the effect of such control on the fishing industry of the area, and the economy of the procedure.

7. Additional data on food habits of sea lions are needed for a more complete understanding of the habits of this mammal.



Fig. 1. Copper River "flats" near the central portion of the delta at ebb tide. The low sandy bars (a) in the foreground were used by harbor seals for resting and pupping. At flood tide these bars were completely covered to the grassy banks (b) far beyond the fishing boat anchorage (c). The two larger boats are fish buyers' scows. Most the salmon gill-netting takes place between the outer bars and the grassy banks which are just above the high tides.



Fig. 2. The Copper River five to ten miles above its mouth. The river splits into many channels in this area and, in the spring, harbor seals move up these channels where they feed extensively on colachan (*Thaleichthys pacificus*). Many pups are born on the sand bars in this vicinity and this is the region where much hunting is done with shotguns and speedboats during the spring pupping season.

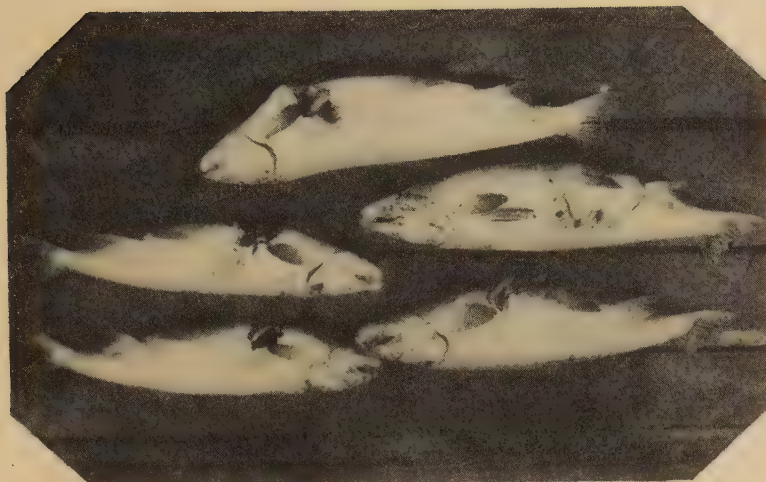


Fig. 3. Silver salmon (Coho) which had been damaged by harbor seals. These salmon were taken from gill nets on the Stikine River where the fish averaged about 11 pounds each. Nearly two percent of the gill-netted salmon which Imler examined showed such predation as this illustrates.



Fig. 4. An anchorage in Gambier Bay on Admiralty Island. An adult female harbor seal weighing about 160 pounds is shown here. The gun is a Mauser Ackley of .270 caliber. The M.S. Black Bear shown in the background, was an ideal boat for navigating the inside channels.



Fig. 5. Newly-born female pup found nearby. Note after-birth at right of seal. The substance to the left of the seal's head is the shed hair from its white, furry, prenatal coat. This hair is "sloughed off" several weeks before birth but remains in the womb until the pup is born.

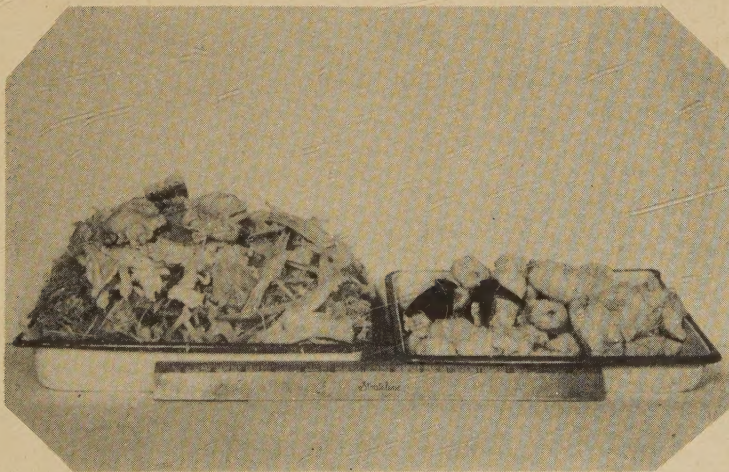


Fig. 6. Contents of one sea lion stomach: About 2 gallons of fish, mostly cod, and one gallon of the remains of a large octopus.

